Impact of early transplanting on tillering and grain yield of irrigated rice

In irrigated rice areas, transplanting is widely practiced as a way to improve weed control and to grow a well-designed canopy with homogeneous and healthy seedlings. The high-yielding ability of this practice is strongly dependent on transplanting age (Om et al 1989; Hossain et al 2001), with farmers transplanting from time to time seedlings as old as 80 days (Khatun et al 2002). The long stay of seedlings in the nursery may, however, affect seedling growth pattern in response to competition (Mandal et al 1984) and may induce high transplanting shock. The objective of this study was to quantify the impact of transplanting age, as early as 7 days, on plant growth and grain yield in subtropical conditions.

Materials and methods

Field experiments were conducted in 2003 at the lowland area of the IRRI experimental farm, Los Baños, Philippines (Fig.1). IR72 and two hybrids, IR75217H (H1) and IR68284H (H2) in the dry season; and IR72, a new plant type IR72967-12-2-3 (N4) and H1 in the wet season were grown in nurseries at 3,000 seeds m^{-2}, either in wet-bed (WB) or seedling trays (ST) and transplanted after 7 (WB07 and ST07), 14 (WB14 and ST14) and 21 days (WB21) at 25 plants m^{-2} in four replications.

Fig. 1. The experimental plot at 21 days after sowing during the dry season.

Results

- Delay in tiller emergence of IR72 by around 15 days with 21-day transplanted seedling over 7-days in the wet season:
  - reduction in maximum tiller number per plant from 34 to 29 (Fig. 2a)
  - reduction in shoot dry matter accumulation at early stages by at least 10 g (Fig. 2c)
  - delay in time of maturity by almost 10 days (Fig. 2c)
- Delay in tiller emergence and shoot dry matter accumulation also observed in the dry season for IR72 (Fig. 2b & 2d) and H2 (Fig. 3b & 3d) and in the wet season for N4 (Fig. 3a & 3c).
- Delay in the increase in leaf number of the main tiller between 16 and 21 DAS in WB21 over WB07 (Fig. 4a). Revival just after transplanting at a comparable rate as in WB07. Plant development in these conditions was rather affected by a nursery stress than a transplanting shock.
- Delay in tiller emergence probably due to the delay in leaf appearance on the main tiller in WB21: primary and branch tiller number per plant both related to the leaf number, whatever the transplanting date (Fig. 4b).

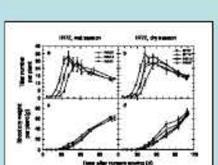

Fig. 2. Change, with days after sowing, in tiller number per plant in the (a) wet and (b) dry seasons, and in shoot dry weight per plant in the (c) wet and (d) dry seasons, of IR72 plants as affected by different nursery management.

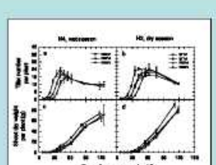

Fig. 3. Change, with days after sowing, in tiller number per plant for (a) N4 in the wet and (b) H2 in the dry seasons, and in shoot dry weight per plant for (c) N4 in the wet and (d) H2 in the dry seasons.

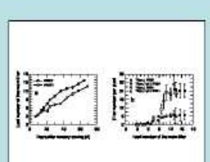

Fig. 4. a, Increase, with days after sowing, in leaf number of the main tiller. b, tiller number per plant as a function of leaf number of the main tiller .

- Significant higher grain yield of IR72 by 7% and of hybrids by 10% of 7day transplanted seedlings over 14 days in the dry season (Table 1). IR72: slight increase in productive tiller number per plant. Hybrids: higher shoot dry weight per productive tiller.

Table 1. Variation in crop duration (C dur, days), duration from sowing to panicle initiation (S-PI, days), grain yield (GYield, t ha^{-1}) and main yield components between IR72, H1 and H2 in the dry season under contrasted nursery management. PtilNb for productive tiller number per plant, ShDW for shoot dry weight per productive tiller (g), HI for harvest index, StDW for stem dry weight per productive tiller (g), FGrDW for filled grain dry weight per productive tiller (g), FGrNB for filled grain number per productive tiller [a].

VAR	TRT	Crop dur (days)	S-PI (days)	GYield (t ha^{-1})	PtilNB (no.)	ShDW (g)	HI	StDW (g)	FiGrDW (g)	FiGrNB (no.)
IR72	ST07	108	51	6.99a	17.08ab	4.32ab	0.44b	1.51a	1.87ab	80.95ab
IR72	ST14	109	53	6.55b	16.19b	4.04bc	0.43b	1.39ab	1.83b	78.42ab
IR72	WB14	108	51	6.34bc	15.77b	4.38a	0.45ab	1.48ab	2.00a	84.61a
IR72	WB21	109	55	6.06c	17.88a	3.94c	0.46a	1.24b	1.82b	76.91b
H2	ST07	115	55	7.58a	13.06a	6.96a	0.42a	2.50a	2.94a	105.95a
H2	ST14	117	58	6.98b	12.94a	5.98b	0.43a	2.07b	2.58b	95.56ab
H2	WB14	117	58	6.81c	12.36a	6.51ab	0.43a	2.23b	2.81a	104.16a
H2	WB21	118	62	6.99b	12.96a	6.32ab	0.40b	2.24b	2.51b	91.88b
H1	ST07	106	46	7.75a	14.79ab	5.52a	0.53b	1.64a	2.91a	121.11a
H1	ST14	107	48	7.59a	14.81ab	4.72c	0.52b	1.27b	2.47b	103.12b
H1	WB14	107	47	6.98a	14.13b	5.21ab	0.55a	1.42b	2.88a	117.60a
H1	WB21	107	50	6.97a	16.08a	4.81bc	0.51b	1.45ab	2.45b	102.57b

[a] Means followed by a common letter are not significantly different at P≤ 0.05 based on LSD.

- Significant higher grain yield of N4 by 78% of 14 day transplanted seedlings over 21 days partly due to a significant higher harvest index (Table 2).
- Comparable grain yield of 7day transplanted seedlings and 14 days for N4, and of 14 day transplanted seedlings and 21days for hybrid and IR72 (Table 2).

Table 2. Variation in crop duration (C dur, days), duration from sowing to panicle initiation (S-PI, days), grain yield (GYield, t ha^{-1}) and main yield components between IR72, N4, and H1 in the wet season under contrasted nursery management. PtilNb for productive tiller number per plant, ShDW for shoot dry weight per productive tiller (g), HI for harvest index, StDW for stem dry weight per productive tiller (g), FGrDW for filled grain dry weight per productive tiller (g), FGrNB for filled grain number per productive tiller [a].

VAR	TRT	Crop dur (days)	S-PI (days)	GYield (t ha^{-1})	PtilNB (no.)	ShDW (g)	HI	StDW (g)	FiGrDW (g)	FiGrNB (no.)
IR72	WB07	108	50	5.32a [a]	15.21a	4.12a	0.35a	1.72a	1.42a	62.76a
IR72	WB14	111	53	5.14b	14.42a	4.16a	0.34ab	1.77a	1.40ab	60.22ab
IR72	WB21	115	55	5.18b	15.64a	3.93a	0.32b	1.72a	1.24b	55.91b
N4	WB07	118	57	4.56a	12.39a	5.96a	0.28a	2.69a	1.65a	61.71a
N4	WB14	121	60	4.62a	11.31a	5.77a	0.26a	2.63a	1.52a	56.62a
N4	WB21	126	63	2.60b	12.04a	5.90a	0.21b	2.90a	1.12b	46.06a
H1	WB07	104	44	6.62a	11.88a	5.18a	0.42a	1.86a	2.18a	93.42a
H1	WB14	106	47	6.02b	13.06a	4.70ab	0.41a	1.72b	1.91a	76.96ab
H1	WB21	111	50	5.89b	14.30a	4.50b	0.35b	1.78b	1.57b	66.52b

[a] Means followed by a common letter are not significantly different at P≤ 0.05 based on LSD.

Conclusion

Early transplanting favored tiller emergence of three different genotypes grown in two types of nurseries during the wet and dry seasons (also reported by Mandal et al 1984). It significantly increased grain yield of hybrid rice and IR72 transplanted as early as 7 days, and of N4 transplanted at 14 days. Early transplanting, particularly as early as 7 days, appears to be a promising way to improve grain yield in rice.

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